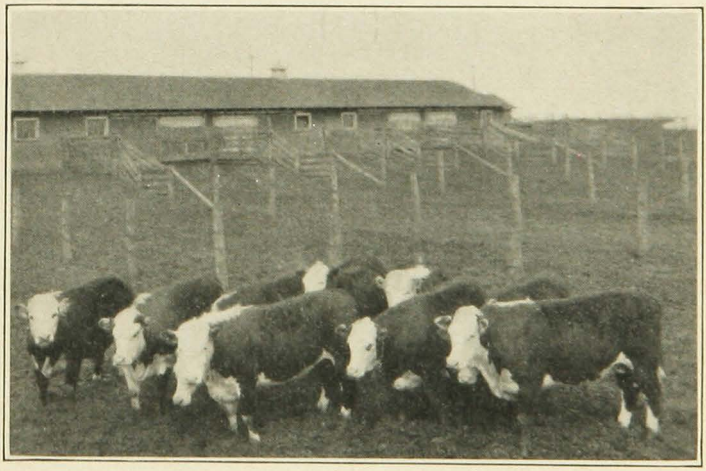
UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

GRINDING SHELLED CORN, BARLEY, AND ALFALFA HAY

FEEDING CANE MOLASSES TO FATTENING CATTLE

PEAT-LAND HAY AS ROUGHAGE FOR CATTLE

W. H. PETERS
DIVISION OF ANIMAL HUSBANDRY



UNIVERSITY FARM, ST. PAUL

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INTRODUCTION

Interest in the subject of grinding feeds for livestock has been greatly stimulated recently because for the first time the question of grinding roughages has come to the front for special attention. Machines that will grind either grain or hay to practically any degree of fineness have been perfected in sizes ranging from those for use on the average farm, where comparatively little grinding is done, to those for use in mixed-feed manufacturing plants.

Questions about ground feed are: Can the farmer increase the net profit by grinding feeds for livestock? What feeds should be ground and for what kinds of feeding? What are the merits of mixing ground grains and ground roughage before feeding? What are the advantages of mixing molasses with the ground grain and ground roughage ration?

The author realizes that the few trials reported can by no means be used as a basis from which to draw conclusions concerning all of the questions involved in feeding ground and mixed feeds to livestock, as all the data reported were secured in the feeding of fattening cattle.

The author desires to acknowledge the assistance of H. W. Vaughan, A. L. Harvey, S. G. Denner, L. M. Winters, and George Wight, each of whom helped to conduct one or more of the several feeding experiments reported in this bulletin.

GRINDING SHELLED CORN, BARLEY, AND ALFALFA HAY

First Trial

During the winter of 1926-27, the first trial to determine the effect of grinding corn and alfalfa hay was conducted with a group of 30 high-grade Hereford yearling feeder steers. In this trial, lasting 180 days, from November 19, 1926 to May 18, 1927, corn and alfalfa hay were the only feeds used, the aim being to fatten the cattle.

The cattle were divided into three lots of 10 each. Lot 1 received a ration of whole shelled corn, full fed, whole alfalfa hay, full fed; Lot 2 ground shelled corn, full fed, whole alfalfa hay, full fed; and Lot 3, ground shelled corn and ground alfalfa hay fed in about the proportion of the two feeds eaten by Lot 1. The simple ration of corn and alfalfa was used because it would give the grinding of the corn and hay the best chance to show its effects. Table 1.

Table 1

Grinding Shelled Corn and Alfalfa Hay for Fattening Yearling Steers

November 19, 1926 to May 18, 1927—180 days

Lot No.	1	2	3
Steers per lot	10	10	10
Ration	Shelled corn Alfalfa hay	Ground shelled corn Ground alfalfa hay	Shelled corn and alfalfa hay ground and mixed
Initial weight, lb.	688.83	688.47	689.33
Final weight, lb.	1105.00	1136.27	1142.17
Average daily gain, lb.	2.31	2.49	2.52
Average daily feed:			
Shelled corn, lb.	15.86	.....	.....
Ground shelled corn, lb.	.....	16.97	17.20
Alfalfa hay, lb.	6.59	6.95	.....
Ground alfalfa hay, lb.	.....	.....	6.44
Feed for 100 lb. gain:			
Shelled corn, lb.	685.80	.....	.....
Ground shelled corn, lb.	.....	681.96	683.53
Alfalfa hay, lb.	285.20	279.32	.....
Ground alfalfa hay, lb.	.....	.....	255.93
Feed cost for 100 lb. gain	$10.08	$10.52	$10.48
Initial cost per cwt.	8.00	8.00	8.00
Initial cost per head	55.11	55.08	55.15
Total cost of feeds	41.94	47.13	47.46
Final cost per head	97.05	102.21	102.61
Selling price, South St. Paul	11.85	12.00	12.00
Selling price, Univ. Farm	11.35	11.50	11.50
Value per head, Univ. Farm	$125.42	$130.67	$131.35
Pork credit per steer, lb.	34.11	16.35	16.31
Pork credit at $10 per cwt.	3.41	1.64	1.63
Margin per steer over feed cost excluding hogs	28.37	28.46	28.74
Margin per steer over feed cost including hogs	31.78	30.10	30.37
Return per bushel shelled corn	$1.21	$1.14	$1.14

Feed prices charged—shelled corn 59 cents per bushel, alfalfa hay $20 per ton. Cost of grinding shelled corn, 8 cents per cwt. Cost of grinding alfalfa hay, $1.35 per ton.

Discussion of Results

1. **Grinding the corn only.**—(Lots 1 and 2.) Grinding the shelled corn increased the daily feed consumption, increased the daily gain, and lessened very slightly the amounts of corn and alfalfa required to produce a pound of gain. The steers in Lot 2 were somewhat fatter at the end of the trial and were valued 15 cents per cwt. higher than those in Lot 1. However, in the ground corn lot, the cost of gain was higher and the pork credit was much lower than in the shelled corn lot. The ground corn lot did not quite equal the shelled corn lot in profit.

2. **Grinding and mixing corn and hay.**—(Lots 1 and 3.) Grinding and mixing the shelled corn and alfalfa hay increased the daily feed consumption, increased the daily gain, and slightly lessened the amounts of corn and alfalfa required to produce a pound of gain. The steers in Lot 3 were somewhat fatter at the end of the trial, but they were also a little more paunchy. Lot 3 was valued 15 cents per cwt. higher than Lot 1. However, in Lot 3 the cost of gain was higher and the pork credit was much lower than in Lot 1. Lot 3 did not quite equal Lot 1 in profit.

3. **Comparison of Lots 2 and 3.**—Both of these lots were fed ground corn. Lot 2 was fed unground alfalfa hay, whereas for Lot 3, the alfalfa was ground and fed mixed with the ground corn. The two lots consumed about the same amounts of feed, made practically the same gain in weight, and the cost of gain was practically the same in the two lots. Lot 3 was a little fatter and slightly more paunchy at the finish than Lot 2. Both lots were given the same final valuation per hundredweight.

The hogs following Lots 2 and 3 made almost identical gains from waste. This indicates that grinding the alfalfa hay and mixing it with the ground corn did not improve the digestibility of the feeds fed to these steers.

Lot 3 returned 27 cents per head more profit over cost of feed than Lot 2, but no charge was made against Lot 3 for the time required to mix the feed. Lot 3 did not surpass Lot 2 in return per bushel of corn. The results show that it was not profitable to grind the alfalfa hay and mix it with the corn in feeding these yearling steers.

Second Trial

The second trial to determine the effect of grinding corn and alfalfa hay for fattening cattle was conducted during the winter of 1927-28, with a group of 20 high-grade Hereford yearling feeder steers.

In this trial, lasting 175 days from November 4, 1927 to April 27, 1928, a fairly complete ration was fed, including shelled corn, linseed

meal, and alfalfa hay, corn fodder being substituted for the alfalfa hay during the first 56 days of the trial. The results of this comparison are given in Table 2.

Table 2

Grinding All Feeds Including Roughage for Fattening Yearling Steers

November 4, 1927 to April 27, 1928—175 days

Lot No.	1	2
No. of animals	10	10
Ration fed	Whole shelled corn Linseed meal Whole corn fodder (56 days) Whole alfalfa hay (119 days)	Ground shelled corn Linseed meal Ground corn fodder (56 days) Ground alfalfa hay (119 days)
Initial weight, lb.	683.20	683.80
Final weight, lb.	1080.20	1085.60
Average daily gain, lb.	2.27	2.30
Average daily feed:		
Ground shelled corn, lb.	.....	13.52
Whole shelled corn, lb.	13.52	.....
Linseed meal, lb.	1.97	1.97
Ground corn fodder, lb.	.....	14.08 (56 days)
Whole corn fodder, lb.	13.76 (56 days)	.....
Ground alfalfa hay, lb.	.....	5.87 (119 days)
Whole alfalfa hay, lb.	5.87 (119 days)	.....
Feed per 100 lb. gain:		
Ground shelled corn, lb.	.....	589.09
Whole shelled corn, lb.	594.58	.....
Linseed meal, lb.	86.72	85.68
Ground corn fodder, lb.	.....	534.50 (56 days)
Whole corn fodder, lb.	565.20 (56 days)	.....
Ground alfalfa hay, lb.	.....	274.98 (119 days)
Whole alfalfa hay, lb.	268.22 (119 days)	.....
Feed cost per 100 lb. gain	$12.68	$13.44
Initial cost per 100 lb.	11.00	11.00
Initial cost per head	75.15	75.21
Total cost of feeds	50.37	54.04
Final cost per head	125.52	129.25
Selling price South St. Paul	13.25	13.20
Selling price Univ. Farm	12.75	12.70
Value per head Univ. Farm	$137.72	$137.87
Pork credit per steer, lb.	27.30	16.60
Pork credit at $8.40 per cwt.	$2.30	$1.40
Margin per steer over feed cost excluding hogs	12.20	8.62
Margin per steer over feed cost including hogs	14.50	10.02
Return per bushel shelled corn	$1.14	$1.04

Feed prices charged: Shelled corn 80 cents per bushel, linseed meal $48 per ton, alfalfa hay $13 per ton, corn fodder $10 per ton. Charge for grinding corn 8 cents per cwt. Cost of grinding roughage, alfalfa hay $2.30 per ton, corn fodder $2.00 per ton.

Discussion of Results

In planning the feeding of the two lots of cattle in this trial, the proportion of ground roughage to ground corn fed Lot 2 was based on the proportionate amount of each feed that fattening cattle consumed

on the average in trials at this and other experiment stations in which whole shelled corn and whole corn fodder or whole alfalfa hay were fed. In working up to a full feed, a mixture of 75 per cent ground corn fodder and 25 per cent ground shelled corn with one pound of linseed meal per head per day added was fed at the beginning, the aim being to feed enough to satisfy the appetite of the cattle, the proportion of corn to corn fodder being increased as the amount of feed was increased and the amount of linseed meal increased until the cattle were getting all the feed they would clean up in two feeds a day. The mixture by that time was composed of 2 pounds linseed meal, 12 pounds ground shelled corn and 8 pounds ground corn fodder per steer per day. At each feeding time, the same amounts of whole shelled corn, whole corn fodder, linseed meal, and alfalfa hay were fed Lot 1 as were contained in the ground mixture fed Lot 2. A ration of corn, alfalfa hay, and linseed meal will often cause a tendency for some cattle to scour during the early part of the feeding period, especially if an attempt is made to bring them up to a full feed of grain in as short a period as three to four weeks. Corn fodder was fed in place of alfalfa hay in the early part of this trial in an effort to alleviate this difficulty, also to demonstrate whether or not farmers could use some corn fodder to advantage in this way, thus saving alfalfa. Throughout the trial, the cattle in Lot 1, receiving unground feeds fed separately, were given exactly the same amounts of each feed at each feeding time as contained in the mixture fed Lot 2. The only exception to this was for about ten days during the early part of the trial when the cattle in Lot 1 were unable to eat quite as much whole corn fodder as the amount included in the ration and consumed by Lot 2 as ground corn fodder.

It will be noticed from the table that differences in all the figures are very small except that the cost of feed is a little higher for Lot 2 than for Lot 1 and the pork credit for Lot 2 is noticeably lower than for Lot 1, leaving a difference of $4.48 per steer in margin over feed cost in favor of Lot 1, the lot fed whole feeds. At the close of the trial, the steers in Lot 1 were given a valuation five cents per 100 pounds higher than that given those in Lot 2. The reason for this slight difference given by the salesman and buyer being that the steers in Lot 2, fed ground feeds, were noticeably more paunchy than those in Lot 1, fed whole feeds.

It was found in this trial that ground corn fodder could not be kept in any considerable bulk for more than two days, even in the coldest weather, without heating and molding. This is due to the high moisture content of corn fodder, in this instance, 35 per cent. Ground alfalfa will keep indefinitely but the job of grinding it is a dusty,

unpleasant one under farm conditions. Once the roughage is ground, it is convenient and pleasant to handle.

The substitution of corn fodder for alfalfa hay in starting the cattle in this trial showed no particular advantage over previous experiments in which alfalfa hay was used from the beginning.

Ground Barley, Whole Barley, or Shelled Corn for Fattening Cattle

The trial conducted during the winter of 1927-28 had two main objects: (1) To compare barley fed ground and fed whole with shelled corn as the grain ration for fattening cattle. (2) To compare the results secured by feeding ground barley as the grain during the first half of the feeding period and shelled corn during the last half, to the feeding of either ground barley or shelled corn throughout the fattening period.

Forty grade Hereford yearling steers purchased on the market at South St. Paul on October 26, 1927, were used in the trial. They were fed in four lots of ten steers each. The four lots received the following rations:

Lot 1. Ground barley full fed, linseed meal 2 pounds per head daily, alfalfa hay and corn silage full fed

Lot. 2 Whole barley full fed, linseed meal 2 pounds per head daily, alfalfa hay and corn silage full fed

Lot 3. Shelled corn full fed, linseed meal 2 pounds per head daily, alfalfa hay and corn silage full fed

Lot 4. Ground barley full fed first 84 days, then shelled corn full fed 91 days. Linseed meal 2 pounds per head daily, alfalfa hay and corn silage full fed.

The feeding of barley to fattening cattle was made one of the subjects for study in this experiment because many cattle are now being grown in sections of the state where corn for grain is not a regularly successful and profitable crop. Cattle can be grown in these sections, however, just as successfully and cheaply as in the corn-growing areas, but the practice of fattening cattle in these areas has not yet developed to an appreciable extent. If barley can be used successfully for fattening cattle, it will be more profitable for farmers in these sections to fatten their cattle before marketing them.

It has commonly been supposed that barley must be ground to be fed to livestock successfully. Our very satisfactory results in feeding whole barley to fattening lambs led us to believe that whole barley might be fed successfully to fattening cattle. If whole barley could be fed successfully and profitably to fattening cattle, the grinding might be eliminated and that time and expense could be saved.

In previous trials in the feeding of ground barley at this and other experiment stations, it has frequently been found that cattle would do

especially well during a short feeding period of 60 to 90 days on ground barley, but that gains would decline during the latter part of a longer feeding period. As there are many localities in Minnesota where both corn and barley are available, it would be possible to feed barley during the early part of the feeding period and corn during the latter part if this practice had any real advantage. (Table 3.)

Table 3

A Comparison of Ground Barley, Whole Barley, and Shelled Corn as the Grain Ration for Fattening Yearling Steers

November 4, 1927 to April 27, 1928—175 days

Lot No.	1	2	3	4
No. of animals	10	10	10	10
Ration fed	Ground barley Linseed meal Alfalfa hay Corn silage	Whole barley Linseed meal Alfalfa hay Corn silage	Shelled corn Linseed meal Alfalfa hay Corn silage	Ground barley (84 days) Shelled corn (91 days) Linseed meal Alfalfa hay Corn silage
Initial weight, lb.	687.20	692.70	681.30	673.70
Final weight, lb.	1081.50	1063.60	1116.30	1092.40
Average daily gain, lb.	2.25	2.12	2.49	2.39
Avg. daily feed:				
Ground barley, lb.	12.48	.....	.....	11.31 (84 days)
Whole barley, lb.	.....	14.84	.....	.....
Shelled corn, lb.	.....	.....	14.34	16.00 (91 days)
Linseed meal, lb.	1.97	1.97	1.97	1.97
Alfalfa hay, lb.	4.29	4.30	4.30	4.30
Corn silage, lb.	12.20	14.76	12.71	12.50
Feed per 100 lb. gain:				
Ground barley, lb.	553.75	.....	.....	226.80
Whole barley, lb.	.....	700.12	.....	.....
Shelled corn, lb.	.....	.....	576.97	347.60
Linseed meal, lb.	87.30	92.82	79.14	82.23
Alfalfa hay, lb.	187.63	202.88	173.11	179.72
Corn silage, lb.	541.54	696.67	511.32	522.09
Feed cost per 100 lb. gain	$13.89	$16.37	$12.54	$13.18
Initial cost per 100 lb.	11.00	11.00	11.00	11.00
Initial cost per head	75.59	76.01	74.94	74.10
Total cost of feeds	54.79	60.73	54.57	55.21
Final cost per head	130.38	136.74	129.51	129.31
Selling price at South St. Paul	13.20	12.95	13.50	13.45
Selling price Univ. Farm	12.70	12.45	13.00	12.95
Value per head Univ. Farm	$137.35	$132.41	$145.12	$141.46
Pork credit per steer, lb.	7.60	33.80	43.10	29.00
Pork credit at $8.40 per cwt.	0.64	2.84	3.62	2.44
Margin per steer over feed cost, excluding hogs	6.97	—4.33	15.61	12.15
Margin per steer over feed cost, including hogs	7.61	—1.49	19.23	14.59
Price returned per bu. of grain	$0.94	$0.73	$1.24	Barley $0.94 Corn 1.22

Feed prices charged: Shelled corn 80 cents per bu., whole barley 76 cents per bu., linseed meal $48 per ton, alfalfa hay $13 per ton, corn silage $5.00 per ton. Charge for grinding grain 8 cents per cwt.

Discussion of Results

Ground barley versus shelled corn, Lots 1 and 3.—It is seen by the figures in Table 3 that Lot 3, the one fed the ration of shelled corn, linseed meal, alfalfa hay, and corn silage, has an advantage over Lot 1, fed ground barley, linseed meal, alfalfa hay, and corn silage, from practically every standpoint. The steers in Lot 3 gained faster, made cheaper gains, sold at a higher price per pound, and returned a considerably larger profit than those of Lot 1. It should be noted, however, that Lot 3 required a few more pounds of shelled corn per 100 pounds of gain than Lot 1 required of ground barley, and that Lot 1 required a little more linseed meal, alfalfa hay, and corn silage than did Lot 3.

This may be accounted for by several known differences between shelled corn and ground barley and by the method of feeding the grain in this trial. Shelled corn is heavier and more concentrated than ground barley and cattle can readily eat more of it than of the ground barley. Shelled corn is also more palatable to cattle than ground barley, and as each lot of cattle had an opportunity to eat about as much grain as they liked, it was but natural that those eating shelled corn would eat more than those eating ground barley.

The corn fed in this trial contained about 5 per cent more moisture than the barley. That difference would also tend to stimulate the consumption of a greater number of pounds of corn than of barley. There are some other differences in the composition of shelled corn and ground barley. Barley contains about 2 per cent more protein than corn, 2.5 per cent more fiber, and 3 per cent less fat. These differences just about balance one another but, because of the higher fat content of corn, it usually has a very slight advantage over barley as a fattening feed. Had the corn been limited to the same number of pounds per day as of barley eaten by the barley-fed cattle, unquestionably less corn and more of the other feeds would have been consumed per 100 pounds gain in the corn-fed lot. This has been demonstrated in previous trials at this experiment station.

Because of the bulk, light weight, and low palatability of the ground barley, it limits consumption and, in all probability, the way to get the cheapest gains from ground barley is to full-feed it, while the way to get the cheapest gains from shelled corn is to limit it to 85 per cent of a full feed or approximately 1.6 pounds of shelled corn per 100 pounds live weight of cattle per day.

Whole barley versus ground barley or shelled corn, Lots 1, 2, and 3.—A comparison of the figures in the table for Lots 1, 2, and 3 reveals that Lot 2, the one fed whole barley, linseed meal, alfalfa

hay, and corn silage, made a poor showing when compared to either Lot 1, fed ground barley, or Lot 3, fed shelled corn. The steers receiving whole barley ate a trifle more grain per day by weight and a little more silage than the steers fed shelled corn and quite a little more grain by weight and a little more silage than the steers getting ground barley. It is surprising at first thought that the steers fed whole barley should eat more than those fed ground barley. Close observation of the three lots of cattle during the feeding trial, however, offers at least a partial explanation.

Barley is a hard grain, small in size, and covered with a fibrous hull. The cattle eating whole barley ate their grain quickly and greedily, always seeming to be more hungry at feeding time than those in either the shelled corn or ground barley lots and always getting their grain cleaned up ahead of the other two lots. Even with this larger daily grain consumption, their daily gains were considerably lower than those in Lots 1 and 3. The steers eating whole barley remained healthy throughout the trial and were not troubled with digestive disorders of any kind. What apparently happened was that they simply swallowed a large part of the barley whole without breaking the kernels and it passed through the digestive tract without being digested. This resulted in a low daily gain, a high feed cost per 100 pounds gain, a poor finish, low selling price per pound, and a small loss per head instead of a profit.

The pigs following the cattle receiving whole barley seemed unable to recover the undigested barley very efficiently. This was probably due to the small size of the barley grains and their dark color.

Effect of Feeding Ground Barley for the First Half of the Feeding Period, then Shelled Corn, Lots 1, 3, and 4

Previous experience in the feeding of fattening cattle on ground barley at this and other experiment stations has shown that fattening cattle fed on ground barley usually do especially well through a short feeding period or during the first two or three months of a long feeding period and then fail to gain as rapidly or as cheaply after they have been on feed 75 to 100 days as do cattle getting shelled corn. Lot 4 was fed ground barley for 84 days and then shelled corn to the end of the feeding period. The steers in this lot during the first 84 days followed very closely those in Lot 1, the lot fed ground barley throughout the feeding period. When they were changed to shelled corn, they followed quite closely those in Lot 3, the lot receiving shelled corn throughout the feeding period, during the latter part of the trial. This put them almost midway between Lots 1 and 3 for the entire period in

rate of gain and feed cost per 100 pounds gain, but brought them up almost to Lot 3 in degree of finish and selling price per pound, at the close of the trial.

There are no apparent advantages of feeding barley during the first part of the feeding period and corn during the latter part, unless a farmer has a partial supply of each grain on hand, in which case he had best feed the barley first and the corn toward the finish.

FEEDING MOLASSES TO FATTENING CATTLE

First Trial

Two feeding trials have been conducted at this experiment station for the purpose of testing the importance and value of cane molasses in the ration for fattening cattle. The first was conducted during the winter of 1928-29, using yearling feeder steers, and the second during the winter of 1929-30, using feeder steer calves.

In the first trial, 60 grade Shorthorn yearling steers, purchased on the market at South St. Paul in November, 1928, were fattened in six lots of ten steers each. They were fed the following rations:

Lot 1. Shelled corn, linseed meal 1½ pounds per head daily, alfalfa hay full fed

Lot 2. Shelled corn, Durham cane molasses 2½ pounds per head daily, alfalfa hay full fed

Lot 3. Shelled corn, linseed meal 1½ pounds per head daily, Durham cane molasses 2½ pounds per head daily, alfalfa hay full fed

Lot 4. Shelled corn, linseed meal 1½ pounds per head daily, Durham cane molasses full fed, alfalfa hay full fed

Lot 5. Ground shelled corn, linseed meal 1½ pounds per head daily, Durham cane molasses 2½ pounds per head daily, ground alfalfa hay (All feeds mixed together before feeding)

Lot 6. Ground barley, linseed meal 1½ pounds per head daily, Durham cane molasses 2½ pounds per head daily. Alfalfa hay full fed.

Number 3 yellow corn and a medium quality of feed barley were used. The corn contained an average of 17.5 per cent moisture and the barley 11.25 per cent moisture. The alfalfa hay was about on the line between the grades standard and No. 2. The molasses was Durham cane and contained 50 per cent combined sugars, 19.78 per cent organic non-sugars, 7.97 per cent ash, and 22.25 per cent moisture. Pea-sized linseed meal was fed with the shelled corn and powdered linseed meal with the ground grain. Table 4 gives the results in this trial.

Table 4

Comparison of Several Rations in a Study of Feeding Cane Molasses to Fattening Yearling Steers

November 23, 1928 to May 3, 1929—161 days

Lot No.	1	2	3	4	5	6
No. of steers	10	10	10	10	10	10
Ration fed	Corn Linseed meal Alfalfa hay	Corn Molasses Alfalfa hay	Corn Linseed meal Molasses Alfalfa hay	Corn Linseed meal Molasses (self-fed) Alfalfa hay	Ground corn Linseed meal Molasses Ground alfalfa hay (fed mixed)	Ground barley Linseed meal Molasses Alfalfa hay
Initial weight, lb.	718.00	722.00	718.00	715.00	722.00	722.00
Final weight, lb.	1127.00	1088.00	1104.00	1127.00	1153.00	1118.00
Av. daily gain, lb.	2.54	2.27	2.40	2.56	2.61	2.46
Av. daily feed:						
Shelled corn, lb.	14.18	14.74	13.90	13.88	.....	.....
Ground shelled corn, lb.	.....	.....	.....	.....	13.82	.....
Ground barley, lb.	.....	.....	.....	.....	.....	14.18
Linseed meal, lb.	1.53	.....	1.53	1.53	1.53	1.53
Molasses, lb.	.....	2.53	2.53	4.36	2.37	2.53
Alfalfa hay, lb.	7.24	7.30	7.30	7.07	.....	6.18
Ground alfalfa hay, lb.	.....	.....	.....	.....	6.06	.....
Feed per 100 lb. gain:						
Shelled corn, lb.	560.50	648.50	580.30	542.60	.....	.....
Ground shelled corn, lb.	.....	.....	.....	.....	516.10	.....
Ground barley, lb.	.....	.....	.....	.....	.....	576.40
Linseed meal, lb.	60.30	.....	63.80	59.80	57.20	62.20
Molasses, lb.	.....	111.30	105.60	170.40	88.60	102.90
Alfalfa hay, lb.	284.80	321.20	304.60	276.30	.....	251.10
Ground alfalfa hay, lb.	.....	.....	.....	.....	226.30	.....
Salt, lb.	1.54	1.58	1.06	1.07	1.16	1.14
Bonemeal, lb.	3.50	3.90	2.93	1.53	3.55	3.61
Feed cost per 100 lb. gain	$ 12.65	$ 14.52	$ 14.98	$ 15.58	$ 13.76	$ 13.99
Initial cost per 100 lb.	11.25	11.25	11.25	11.25	11.25	11.25
Initial cost per head	80.77	81.22	80.77	80.44	81.22	81.22
Total cost of feeds	51.74	53.14	57.82	64.19	59.30	45.40
Final cost per head	132.51	134.36	138.59	144.63	140.52	136.62
Selling price at South St. Paul	14.10	14.00	14.10	14.05	14.10	13.80
Selling price Univ. Farm	13.35	13.25	13.35	13.30	13.35	13.05
Value per head Univ. Farm	$150.45	$144.16	$147.38	$149.89	$153.92	$145.90
Pork credit, lb.	28.60	37.00	45.30	28.10	2.50	0.00
Pork credit at $10 per cwt.	$ 2.86	$ 3.70	$ 4.53	$ 2.81	$ 0.25	$ 0.00
Margin per steer over feed cost excluding hogs	17.94	9.80	8.79	5.26	13.40	9.28
Margin per steer over feed cost including hogs	20.80	13.50	13.32	8.07	13.65	9.28
Price returned per bu. of grain	1.36	1.18	1.17	1.07	1.22	0.83

Feed prices charged: Shelled corn 85 cents per bu., whole barley 64 cents per bu., pea-size linseed meal $62 per ton, powdered linseed meal $61 per ton, molasses $38 per ton, alfalfa hay $15 per ton, salt $30 per ton, bonemeal $60 per ton. Charge for grinding grain, 8 cents per cwt., charge for grinding hay $2.30 per ton.

Discussion of Results

Linseed meal vs. molasses (Lots 1 and 2).—That molasses is not a successful substitute for linseed meal to supplement the ration of corn and alfalfa hay is clearly shown by the results with Lots 1 and 2 in this trial. Lot 1, the one receiving shelled corn, alfalfa hay, and 1½ pounds linseed meal, made larger daily gains, required less feed per 100 pounds gain, at a lower cost per 100 pounds gain, showed a higher finish, a trifle higher selling price, and a greater profit per head by $7.30 than Lot 2 receiving shelled corn, alfalfa hay, and 2½ pounds of molasses. We may give credit to the molasses for stimulating a trifle greater feed consumption in this lot, but neither the molasses itself nor the small increase in the amount of corn and hay consumed contained sufficient nutritive value to balance the nutritive value of the 1½ pounds of linseed meal fed in Lot 1. Neither of the two lots had any advantage over the other so far as the condition of the digestive systems of the animals were concerned. No steer in either lot missed a single feed during the entire feeding period.

Corn-alfalfa, linseed meal, plus molasses (Lots 1 and 3).—In this trial, as in a number of other cattle-fattening trials that have been conducted by this and other experiment stations, the ration of corn, alfalfa hay, and linseed meal has always given a very good account of itself and has come to be considered a good standard ration for fattening cattle. By comparing the figures for Lots 1 and 3, it will be seen that adding molasses at the rate of 2½ pounds per day per steer did not improve the results in any way, but rather seemed to detract from the effectiveness of the standard ration.

Molasses might have had a fairer chance to make a showing in this ration if the amount of corn had been limited to 2½ pounds per head per day less than the amount eaten by Lot 1 and the 2½ pounds of molasses used to replace 2½ pounds of corn. One of the valuable qualities of molasses, however, is considered to be its appetizing effect, inducing cattle to eat more of the other feeds. As the cattle in Lot 3 seemed to take about the same amount of corn as those in Lot 1 without being crowded, they were allowed to have it to find out whether or not this appetizing quality of molasses was of real value when good corn and alfalfa hay were fed. In this case the increased feed consumption was not beneficial in any way, principally because of its higher cost. The ration of corn, alfalfa, linseed meal, plus molasses was less profitable than the same ration minus the molasses.

Molasses self-fed (Lot 4).—One of the questions always asked by the beginner in molasses feeding is "How do you feed it?" or "How do you handle it?"

Self-feeding molasses by building a feed bunk just a little larger than a molasses barrel, setting the barrel on end in the bunk, taking out the small plug in a metal barrel or boring a three-quarter or one-inch hole in a wooden barrel, and letting the molasses run out has been recommended as a method that greatly simplifies feeding it. The molasses will automatically stop running when the amount in the bunk gets deep enough to rise above the hole in the barrel. If allowed to take care of itself in this way, there will always be molasses in the bunk and the cattle can eat all they want of it.

Lot 4 in this trial was self-fed molasses by this method, after having been accustomed to it by feeding gradually increasing amounts during the first four weeks, until they were up to about a full feed of grain and were eating 5 pounds of molasses each per day. When the self-feeding of molasses was begun, the steers in Lot 4 were receiving 14 pounds of shelled corn, 1½ pounds of linseed meal, 5 pounds of molasses, and 6 pounds of hay per day. They immediately went up to a consumption of 9 pounds of molasses per head per day in addition to the other feeds, except that they ate a little less hay. The digestive system became quite laxative in condition, but no steer in the lot lost his appetite or could be considered off feed during the entire period. After about a month of this heavy consumption of molasses, they gradually dropped back until they were eating less than 3 pounds per head per day. In the meantime, the corn had been increased some, and was kept about on a level with the amount of corn eaten by Lot 3. About four weeks before the close of the trial, and after the consumption of molasses had dropped down to less than 3 pounds per head per day, it was thought that possibly the cattle did not like to eat the molasses that had remained in the bunk several days and been licked over, so the bunk was taken out and a clean metal trough put in and just enough molasses to last a day at a time was placed in the trough. The consumption of molasses was increased some after this change was made, but not very much. It seems, therefore, that cattle will tire of molasses in time. A good gain and a good finish were secured on the cattle in this lot, but these advantages did not make up for the higher cost of the ration and the profit was lower than with the standard ration (Lot 1) or the standard ration plus molasses limited to 2½ pounds per day (Lot 3).

Grinding and mixing shelled corn, alfalfa hay, linseed meal, and molasses (Lot 5).—This ration might be called a home-made mixed ration and was kept as nearly as possible equal in amount of feed fed with Lot 3, the difference being that in Lot 3 the shelled corn and alfalfa hay were fed whole, while in Lot 5 both were ground and all feeds mixed together before feeding. The cattle in Lot 5 had three

months of very large gains, the first, fourth, and fifth, and two months of low gains, the second and third. During the second month, three steers in Lot 5 developed a condition of chronic bloating and after about four weeks were removed and replaced with three others as nearly like them as could be secured. How or why three steers in this lot happned to become chronic bloaters we are unable to explain but do not believe it was due particularly to the grinding of the feeds or to the mixing of them before feeding, because this is the only experience of bloating we have had in feeding ground mixed feeds in several trials during the last several years. Neither do we believe that the substitution of the three steers influenced the results materially either favorably or unfavorably. The daily gains for Lot 5 were larger and the feed requirement per 100 pounds gain was lower than in Lot 3, fed whole corn and whole hay, but the selling price per pound was the same and the cost of grinding the feeds, together with the low gains made by the pigs following, prevented any appreciable increase in profit as a result of the grinding and mixing of the corn and hay. The ground and mixed feed has to its credit 33 cents per steer more than the feeds fed whole.

Is molasses more valuable when used to supplement barley than when used to supplement corn? (Lots 6 and 3).—Lots 6 and 3 were fed the same except that in Lot 6 ground barley replaced shelled corn. A comparison of the figures for Lot 6 and Lot 3 show that the barley-fed cattle, receiving molasses plus linseed meal and alfalfa hay, actually outgained the corn-fed cattle receiving molasses plus linseed meal and alfalfa hay. The two lots ate almost the same number of pounds of feed, tho the barley cattle ate a trifle more grain and a little less hay than the corn-fed cattle. Charging shelled corn at 85 cents per bushel and whole barley at 64 cents, however, the corn-fed cattle showed the larger profit by $4.04 per head. This was due principally to the higher finish and higher selling price of the corn-fed cattle. The cost of grinding with barley and failure of the hogs following the barley cattle to make any gain from salvaged feed, helped to lower the profit from the barley-fed group.

One problem in fattening cattle on barley is that after 75 to 90 days on feed, cattle tire of it and do not eat well. Judging by the results secured with this Lot 6, it is just possible that the appetizing quality of the molasses may have a decided value when used along with barley. This question will receive further attention in our experimental work.

FEEDING MOLASSES TO FATTENING CATTLE

Second Trial

The second trial in the feeding of cane molasses to fattening cattle was conducted during the winter of 1929-30. In this trial sixty grade Hereford steer calves were purchased on the market at South St. Paul late in November and fattened in six lots of ten calves each. The six lots of calves were fed the following rations:

Lot 1. Shelled corn full fed, linseed meal 1½ pounds per head daily, alfalfa hay full fed

Lot 2. Shelled corn plus 2 pounds cane molasses total equal to amount of shelled corn consumed by Lot 1, linseed meal 1½ pounds per head daily, alfalfa hay equal to amount consumed by Lot 1

Lot 3. Ground shelled corn equal to amount consumed by Lot 1, linseed meal 1½ pounds per head daily, ground alfalfa hay equal to amount consumed by Lot 1 (All feeds mixed before feeding)

Lot 4. Ground shelled corn plus 2 pounds cane molasses total equal to amount of shelled corn consumed by Lot 1, linseed meal 1½ pounds per head daily, ground alfalfa hay equal to amount consumed by Lot 1 (All feeds mixed together before feeding)

Lot 5. Ground barley full fed, linseed meal 1½ pounds per head daily, alfalfa hay full fed

Lot 6. Ground barley full fed, cane molasses 2 lbs. per head daily, linseed meal 1½ pounds per head daily, alfalfa hay full fed.

Number 3 yellow corn and a good quality of feed barley were fed in this trial. The corn contained an average of 17.5 per cent moisture and the barley 11.5 per cent moisture. The alfalfa was about on the line between standard and No. 2. The molasses was Durham cane and contained 50 per cent combined sugars, 19.78 per cent organic non-sugars, 7.97 per cent ash, and 22.25 per cent moisture. Pea-sized linseed meal was fed with the shelled corn and powdered linseed meal with the ground grain. The results secured in this trial are presented in Tables 5 and 6.

Table 5

A Comparison of Several Rations in a Study of Feeding Cane Molasses and Grinding and Mixing Feeds for Fattening Steer Calves

December 13, 1929 to June 20, 1930—189 days

Lot No.	1	2	3	4
No. of steers	10	10	10	8*
Ration fed	Shelled corn Linseed meal Alfalfa hay	Shelled corn Molasses Linseed meal Alfalfa hay	Ground shelled corn Linseed meal Ground alfalfa hay (mixed)	Ground shelled corn Molasses Linseed meal Ground alfalfa hay (mixed)
Initial weight, lb.	450.50	453.30	450.00	444.90
Final weight, lb.	933.70	887.30	909.90	913.90
Average daily gain, lb.	2.56	2.30	2.43	2.48
Av. daily feed:				
Shelled corn, lb.	12.81	10.90	.....	.....
Ground shelled corn, lb.	.....	.....	12.38	10.88
Linseed meal, lb.	1.47	1.47	1.47	1.47
Molasses, lb.	.....	1.91	.....	1.91
Alfalfa hay, lb.	3.60	3.60	.....	.....
Ground alfalfa hay, lb.	.....	.....	3.44	3.36
Salt, lb.	0.023	0.020	0.027	0.023
Bonemeal, lb.	0.020	0.015	0.017	0.020
Feed per 100 lb. gain:				
Shelled corn, lb.	500.94	474.70	.....	.....
Ground shelled corn, lb.	.....	.....	508.90	439.02
Linseed meal, lb.	57.35	63.86	60.10	59.09
Molasses, lb.	.....	83.02	.....	76.80
Alfalfa hay, lb.	141.02	157.40	.....	.....
Ground alfalfa hay, lb.	.....	.....	141.35	148.00
Salt, lb.	0.009	0.008	0.011	0.009
Bonemeal, lb.	0.007	0.006	0.007	0.008
Feed cost per 100 lb. gain	$ 9.70	$ 10.89	$ 10.47	$ 10.61
Initial cost per 100 lb.	13.50	13.50	13.50	13.50
Initial cost per head	60.81	61.20	60.75	60.06
Total cost of feeds	46.87	47.26	48.15	49.76
Final cost per head	107.68	108.46	108.90	109.82
Selling price South St. Paul	11.15	10.60	10.50	10.75
Selling price, Univ. Farm	10.40	9.85	9.75	10.00
Value per head, Univ. Farm	$97.10	$87.40	$88.72	$91.39
Pork credit per steer, lb.	33.47	49.38	16.80	5.42
Pork credit at $9.25 per 100 lb.	$3.10	$4.57	$1.55	$0.50
Margin per steer over feed cost excluding hogs	—$10.58	—21.06	—20.18	—18.43
Margin per steer over feed cost including hogs	—7.48	—16.49	—18.63	—17.93
Price returned per bu. of corn	$0.61	$0.33	$0.34	$0.30

Feed prices charged: Shelled corn 78 cents per bu., pea-size linseed meal $56 per ton, molasses $30 per ton, alfalfa hay $15 per ton, salt $1.50 per cwt., bonemeal $3.25 per cwt. Charge for grinding grain 8 cents per cwt. Charge for grinding hay $2.30 per ton.

* Two steers died during progress of trial.

Table 6

A Comparison of Several Rations in a Study of Feeding Cane Molasses with Barley to Fattening Steer Calves

December 13, 1929 to June 20, 1930—189 days

Lot No.	1	5	6
No. of steers	10	10	10
Ration fed	Shelled corn Linseed meal Alfalfa hay	Ground barley Linseed meal Alfalfa hay	Ground barley Linseed meal Molasses Alfalfa hay
Initial weight, lb.	450.50	449.80	450.00
Final weight, lb.	933.70	897.20	900.00
Av. daily gain, lb.	2.56	2.37	2.38
Av. daily feed:			
Shelled corn, lb.	12.81	.....	.....
Ground barley, lb.	.....	12.66	12.19
Linseed meal, lb.	1.47	1.47	1.47
Molasses, lb.	.....	.....	1.91
Alfalfa hay, lb.	3.60	3.82	3.28
Salt, lb.	0.023	0.026	0.016
Bonemeal, lb.	0.020	0.014	0.011
Feed per 100 lb. gain:			
Shelled corn, lb.	500.94	.....	.....
Ground barley, lb.	.....	534.89	512.04
Linseed meal, lb.	57.35	61.95	61.59
Molasses, lb.	.....	.....	80.06
Alfalfa hay, lb.	141.02	161.45	137.86
Salt, lb.	0.009	0.011	0.006
Bonemeal, lb.	0.007	0.006	0.005
Feed cost per 100 lb. gain	$ 9.70	$ 9.54	$ 9.95
Initial cost per 100 lb.	13.50	13.50	13.50
Initial cost per head	60.81	60.72	60.75
Total cost of feeds	46.87	42.68	44.77
Final cost per head	107.68	103.40	105.52
Selling price, South St. Paul	11.15	11.00	10.25
Selling price, Univ. Farm	10.40	10.25	9.50
Value per head, Univ. Farm	$97.10	$91.96	$85.50
Pork credit per steer, lb.	33.47	10.60	14.20
Pork credit at $9.25 per cwt.	$ 3.10	$ 0.98	$ 1.31
Margin per steer over feed cost excluding hogs	—10.58	—11.44	—20.02
Margin per steer over feed cost including hogs	—7.48	—10.46	—18.71
Price returned per bu. of grain	$0.61	$0.34	$0.18

Feed prices charged: Shelled corn 78 cents per bu., whole barley 55 cents per bu., pea-size linseed meal $56 per ton, molasses $30 per ton, alfalfa hay $15 per ton, salt $1.50 per cwt., bonemeal $3.25 per cwt. Charge for grinding grain, 8 cents per cwt.

Discussion of Results

Substituting 2 pounds of molasses for 2 pounds of shelled corn (Lots 1 and 2).—It should be kept in mind that in feeding Lots 1 and 2, Lot 1 was full fed shelled corn, 1½ pounds linseed meal per head per day, and full fed alfalfa hay. Lot 2 was fed exactly the same amount of feed and the same feeds except that 2 pounds of molasses per steer per day replaced 2 pounds of shelled corn. By feeding in this way, molasses was robbed of its appetizing effect and made

to show its value pound for pound as compared with corn. That molasses does have an appetizing effect was clearly demonstrated in the feeding of these two lots of cattle. Lot 2 would have consumed a little more feed at every feeding time throughout the entire trial, while Lot 1 had all the feed it would clean up at every feed. The question will at once be asked, "What would have happened had Lot 2 been allowed all the corn and hay they would eat in addition to the 2 pounds of molasses per head per day?" This question is answered by Lots 1 and 3 in the first trial conducted and reported in Table 4, where in Lot 3 the molasses was allowed to exert its appetizing effect and the cattle were fed all the corn and hay they would eat. In that trial the result was similar in all respects to the result in this trial. A careful study of the figures in Table 1 shows that Lot 1 fed corn, linseed meal, and alfalfa gained one-fourth pound per day more, required less feed per 100 pounds gain, made 100 pounds gain at a lower feed cost by $1.19, sold for 55 cents a hundred pounds more, and made a smaller loss by $9.01 per steer than Lot 2, fed molasses.

Grinding and mixing shelled corn, alfalfa hay, and linseed meal (Lots 1 and 3).—Lot 3 was fed exactly the same amounts of feed as Lot 1 except on a few occasions when Lot 3 would not eat quite as much feed as Lot 1. The shelled corn and alfalfa were fed whole to Lot 1 and were fed ground and mixed to Lot 3. The cattle in Lot 1 gained 0.13 pound per day more, required less feed per 100 pounds gain, made their gains at a lower cost by 77 cents per 100 pounds, sold for 65 cents per 100 pounds more, and made a smaller loss by $11.15 per steer than Lot 3 fed the ground mixed ration.

Adding molasses to the ground mixed ration (Lots 3 and 4).—Lots 3 and 4 were fed exactly the same amounts of feed except occasionally when Lot 3 failed to eat quite as much feed as Lot 4. Both lots had all feeds ground and mixed. Lot 4 had 2 pounds of ground shelled corn replaced by 2 pounds of molasses per steer per day. Two steers in Lot 4 died during the progress of the trial, one on January 30 and one April 19. Both steers were figured out of the trial by eliminating them from the weight records and deducting the average amount of feed consumed per steer during the time they were in the trial. Both steers died suddenly, having eaten as usual at the last feeding time. Post-mortem examinations failed to determine the exact cause of death except that death in each case was probably due to acute bloat. Neither steer had been a chronic bloater. Lots 3 and 4 compare very closely in all respects except that a slightly higher feed cost per 100 pounds gain for Lot 4 was a little more than made up for by a selling price of 25 cents per 100 pounds higher for Lot 4 than Lot 3.

Shelled corn compared to ground barley (Lots 1 and 5).—Lots 1 and 5 were each allowed to eat as much grain and hay as they cared

for. Lot 1 received shelled corn, alfalfa hay, and linseed meal; Lot 5 was fed ground barley, alfalfa hay, and linseed meal. While the larger gain and slightly higher selling price of Lot 1 over Lot 5 gave Lot 1 a slight advantage, the lot of barley-fed cattle made a very creditable showing in this trial.

Adding molasses to the ground barley ration (Lots 5 and 6).— Cattle fed ground barley often lose their appetite and consume less barley after having been on feed for 75 to 100 days. In adding molasses to the ground barley ration in Lot 6, the barley was full fed and 2 pounds of molasses per steer per day added. In other words, the molasses in the ration for Lot 6 was allowed to exert its appetizing effect in the hope that it would keep up the consumption of barley and result in larger gains and a higher finish and higher selling price at the close of the trial. A study of the figures in the table shows that the molasses did exert an appetizing effect, because the cattle in this lot ate almost as much barley as those in Lot 5 and the 2 pounds of molasses besides. The additional consumption of feed, however, failed to produce a larger gain or a higher finish, and we find that Lot 5 fed barley without molasses required less feed per 100 pounds gain, made 100 pounds gain at a lower feed cost by 41 cents, sold for 75 cents a hundred pounds more, and made a smaller loss by $8.25 per steer than Lot 6, fed barley plus 2 pounds of molasses per head per day.

PEAT-LAND HAY AS ROUGHAGE FOR CATTLE

Peat soil is found in many locations throughout the United States. In the cut-over timber region of Minnesota, many areas ranging in size from less than an acre to several thousand acres in one area are to be found. In all, there are seven million acres of peat land in Minnesota. In the past, this peat land has been generally considered unsuitable and unprofitable for cultivation. This is often true because the peat beds are underlaid with water and the surface, at least, must be drained before they can be cultivated. It is then found that timothy and alsike clover mixtures grow especially well on this land. It is also found, however, that hay grown on natural peat land is generally quite unpalatable to livestock and animals will not do well on it. A chemical analysis of samples of peat soil from different locations reveals quite a wide variation in composition but generally shows a very high nitrogen content and a very low calcium and phosphorus content. Likewise, hay grown on natural peat soil is high in nitrogen and low in mineral or ash content. It has been found that fertilizing this land with commercial fertilizers high in phosphorus and calcium not only results in a very heavy hay crop but produces hay of high phosphorus and calcium content as well as high protein content.

If the application of commercial fertilizers of high calcium and phosphorus content would also improve the palatability and feeding quality of this peat-land hay, much of this peat land could be made to produce a profitable crop. A feeding trial was conducted during the winter of 1926-27 in which the palatability as well as the feeding value of the peat-land hay for beef cattle was tested.

Thirty medium grade Hereford yearling steers were used in the trial. They were fed in three lots of ten each. The trial was conducted in two periods. During the first period of 90 days (December 10, 1926 to March 10, 1927), Lot 1 was full fed on timothy hay grown on high normal soil as their only feed, Lot 2 was full fed peat-land timothy hay (from well fertilized fields), and Lot 3 was fed peat-land timothy hay (from well fertilized fields) plus animal feed bonemeal. All lots had water and salt before them at all times. The cattle were fed in this way on hay alone to make a thoro test of the palatability of the peat-land hay as well as to test its ability to produce gains compared to the upland timothy. The bonemeal was fed to Lot 3 to determine whether or not the addition of a high phosphorus and calcium supplement to the peat-land hay would increase its efficiency. Both

hays used in this trial contained some traces of alsike clover. The upland hay contained a little less clover than the peat land hay, tho the difference was slight. Chemical analysis of the two hays gave the following phosphoric acid and protein content.

	Phophoric acid Per cent	Crude protein Per cent
Upland timothy	0.21	6.50
Peat-land timothy	0.38	10.69

Results of this trial are given in Table 7.

Table 7

Comparison of Peat-Land and Upland Timothy Hays

December 10, 1926 to March 10, 1927—90 days

Lot No.	1	2	3
No. of steers	10	10	10
Ration	Upland hay	Peat-land hay	Peat-land hay Bonemeal
Initial weight, lb.	712.03	711.83	711.00
Final weight, lb.	781.37	819.13	815.35
Average daily gain, lb.	0.77	1.19	1.16
Average daily feed:			
Upland hay, lb.	18.26	.....	.....
Peat-land hay, lb.	.....	19.22	18.89
Bonemeal, lb.	.....	.....	0.205
Feed for 100 lb. gain:			
Upland hay, lb.	2370.40	.....	.....
Peat-land hay, lb.	.....	1612.35	1626.66
Bonemeal, lb.	.....	.....	17.65
Feed cost per 100 lb. gain	$18.96	$12.90	$13.54
Initial cost per cwt.	7.50	7.50	7.50
Initial cost per head	53.40	53.39	53.33
Total cost of feeds	13.15	13.84	14.16
Final cost per head	66.55	67.23	67.49
Selling price, South St. Paul	8.35	8.60	8.60
Selling price, Univ. Farm	7.85	8.10	8.10
Value per head, Univ. Farm	61.34	66.35	66.06
Margin per steer over feed cost	—$5.21	—$0.88	—$1.43

Feed prices charged: Upland timothy hay $16 per ton, peat-land timothy hay $16 per ton, raw bonemeal $60 per ton.

In judging of the results secured in this trial, it must be kept in mind that the object was to determine the palatability and feeding value of the peat-land hay as compared to upland hay and not to demonstrate the suitability of either as the only feed for cattle. The peat-land hay used proved slightly more palatable than the upland hay. The peat-land hay produced larger and more economical gains. While the cattle in Lot 3 consumed an appreciable amount of bonemeal, no benefits that could be observed were obtained by adding it to the peat-land hay ration. This indicated that the peat-land hay from well fertilized fields contained sufficient digestible phosphorus and calcium to meet the requirements of yearling steers.

Peat-land hay as the roughage in the fattening ration.—In the second period of the trial with peat-land hay, it was fed in comparison with alfalfa in addition to shelled corn as the grain. The thirty steers used in the first trial were relotted, each new lot of ten steers containing three or four steers from each of the three lots used in the first trial. Five hogs followed each lot of steers during this trial. Lot 1 was full fed shelled corn and alfalfa hay, Lot 2 was full fed shelled corn and peat-land timothy hay, and Lot 3 full fed shelled corn, linseed meal 2 pounds per head daily and full fed peat-land timothy hay. Salt and water were before all lots at all times.

Because of the good showing made in the first part of the trial by the peat-land hay when fed alone in comparison to timothy grown on normal soil, it was decided to give the peat-land timothy hay grown on fertilized peat soil a chance to show what it could do in competition with alfalfa. The results secured are given in Table 8.

Table 8

A Comparison of Alfalfa Hay and Peat-Land Timothy Hay Fed with Shelled Corn for Fattening Yearling Steers

March 12. 1927 to June 30, 1927—110 days

Lot No.	1	2	3
Ration	Shelled corn Alfalfa hay	Shelled corn Peat-land timothy hay	Shelled corn Linseed meal Peat-land timothy hay
Initial weight, lb.	806.23	805.07	804.73
Final weight, lb.	1078.10	1062.20	1092.40
Average daily gain, lb.	2.47	2.34	2.62
Average daily feed:			
Shelled corn, lb.	16.89	17.25	16.74
Linseed meal, lb.	.....	.....	2.00
Alfalfa hay, lb.	7.52	.....	.....
Peat-land timothy hay, lb.	.....	7.51	7.09
Feed for 100 lb. gain:			
Shelled corn, lb.	683.27	738.11	640.11
Linseed meal, lb.	.....	.....	76.48
Alfalfa hay, lb.	304.37	.....	.....
Peat-land timothy hay, lb.	.....	322.64	271.18
Feed cost per 100 lb. gain	$11.13	$11.31	$11.65
Initial cost per cwt.	8.00	8.00	8.00
Initial cost per head	64.50	64.41	64.38
Total cost of feeds	30.25	29.08	33.50
Final cost per head	94.75	93.49	97.88
Selling price, South St. Paul	11.25	10.65	11.55
Selling price, Univ. Farm	10.75	10.15	11.05
Value per head, Univ. Farm	$115.90	$107.81	$120.71
Pork credit per steer, lb.	16.48	37.80	34.50
Pork credit at $8.00 per cwt.	$1.32	$3.02	$2.76
Margin per steer over feed cost excluding hogs	21.15	14.32	22.83
Margin per steer over feed cost including hogs	22.47	17.34	25.59
Return per bushel of shelled corn	$1.33	$1.16	$1.43

Feed prices charged: Shelled corn 65 cents per bu., linseed meal $50 per ton, alfalfa hay $21 per ton, peat land timothy hay $17 per ton.

The significant results secured in this trial are that the cattle in Lot 2 receiving shelled corn and peat-land timothy hay made gains closely approaching the gains made by the cattle in Lot 1, receiving shelled corn and alfalfa. The cattle in Lot 3 receiving 2 pounds of linseed meal per head daily along with the ration of shelled corn and peat-land timothy hay made an average daily gain of 2.62 pounds as compared to 2.34 pounds for Lot 2 and 2.47 pounds for Lot 1. The margin of profit over feed cost for Lot 3 was also greater than for Lot 2 or Lot 1, showing that even with the high-protein content of the peat-land hay, it can profitably be supplemented with a high-protein concentrate.

It is concluded from this trial that timothy or timothy and alsike clover mixed hay grown on properly fertilized peat soil can be depended upon to show at least normal composition, palatability, and feeding value when contrasted with similar hay grown on normal upland soil.

CONCLUSIONS

1. When fattening cattle are being fed a ration of shelled corn and alfalfa hay, both feeds of fair quality, and hogs are following the cattle, no worth-while advantage is to be gained by grinding either the corn or the alfalfa or by grinding both and mixing before feeding.

2. Because of the large percentage of whole barley that is not digested and the inability of pigs to salvage it successfully, barley should be ground medium fine when fed to fattening cattle.

3. Ground barley and shelled corn can be combined quite satisfactorily for fattening cattle by feeding ground barley during the first half of the feeding period and shelled corn during the latter half.

4. Cane molasses when fed to fattening cattle in either small or large amounts does exert an appetizing effect causing the cattle to consume slightly larger amounts of feed than they otherwise would.

5. When a suitable ration of palatable feeds is being fed to fattening cattle, under conditions prevailing in Minnesota, the use of either small or large amounts of molasses in the ration has little effect upon the daily rate of gain and tends to lower the margin of profit over feed cost rather than to raise it.

6. When corn is the grain fed, and hogs are following the cattle, the advantage of grinding and mixing all feeds, including molasses, has little to recommend it over the feeding of all feeds whole, from

the standpoint of increasing the daily rate of gain, and nothing to recommend it from the standpoint of increasing profits.

7. Timothy or timothy and alsike clover mixed hay grown on properly fertilized peat soil will be palatable to cattle and show a feeding value equal or superior to similar hay grown on normal upland soil.